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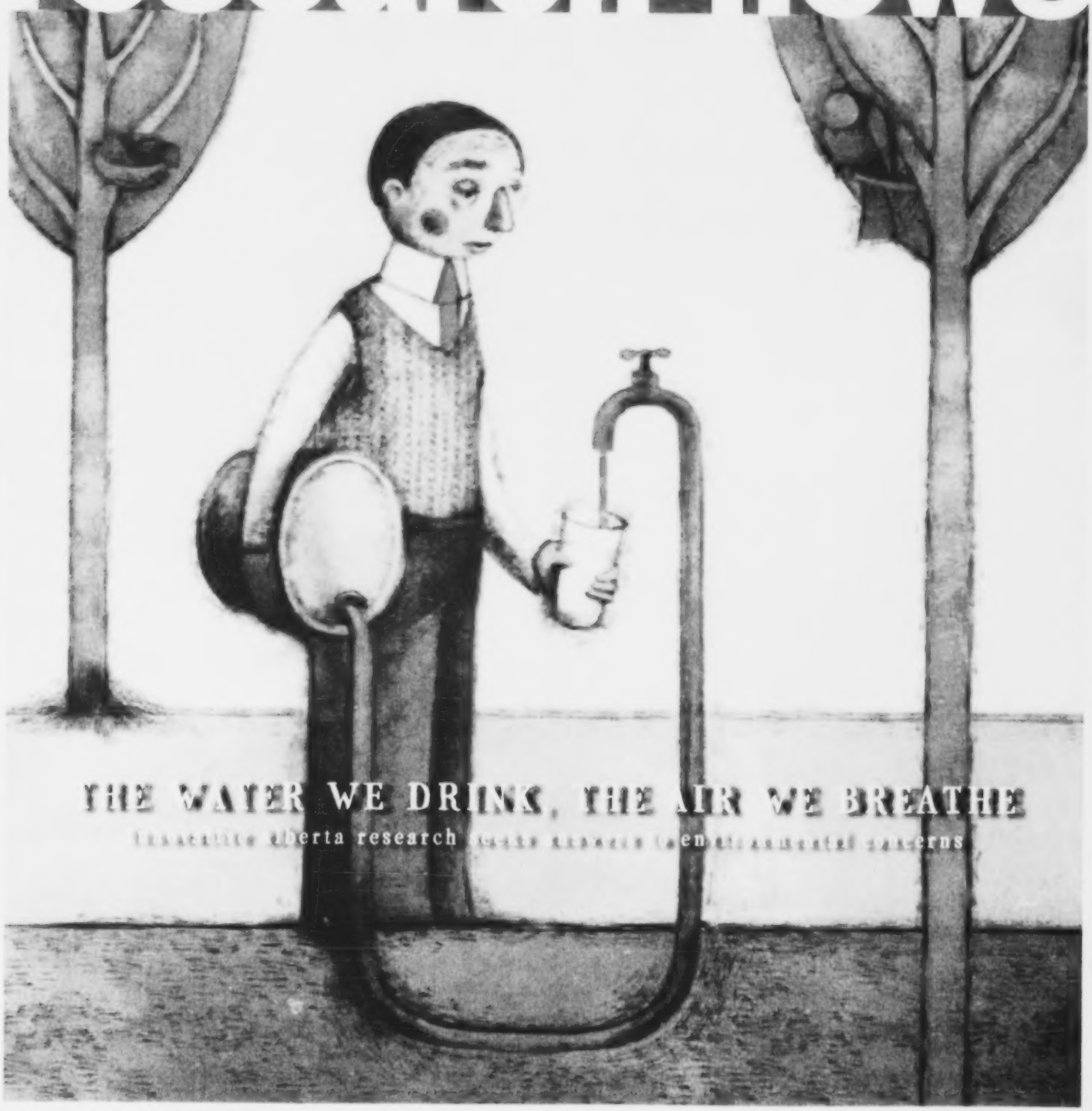

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Regular features

AHFMR Mission

AHFMR supports a community of researchers who generate knowledge that improves the health and quality of life of Albertans and people throughout the world. AHFMR's long-term commitment is to fund basic, patient and health research based on international standards of excellence and carried out by new and established investigators and researchers in training.

Contact Us:

Your comments, views and suggestions are welcome. Please forward them to:

The Editor, AHFMR Research News
Alberta Heritage Foundation
for Medical Research
Suite 1500,
10104 - 103 Avenue
Edmonton, Alberta T5J 4A7

Phone: (780) 423-5727
Fax: (780) 429-3509
E-Mail: postmaster@ahfmr.ab.ca
Internet: http//www.ahfmr.ab.ca

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Research Views

When Daria Wallsten first heard about the SEARCH program, she knew it was something she wanted to do. SEARCH, which stands for Swift Efficient Application of Research in Community Health, is administered by AHFMR. Its goal is to train people in applied health research and the use of research evidence in making decisions about health services. Since its establishment in 1996, the program has successfully coached more than 50 health practitioners in the how-to's of conducting relevant research, accessing and assessing high-quality information, and applying research results in decision-making.

Wallsten, now Director of Planning and Service Development for the Keeweetinok Lakes Regional Health Authority (RHA), immediately saw the relevance of SEARCH to her job and her employer. The region covers a large area 300 kilometres north of Edmonton and provides services to a diverse population of approximately 26,000 people.

"Keeweetinok Lakes is a unique region with unique health-service needs," says Wallsten. "The health services we deliver must reflect these differences and make a difference to our residents. This is where SEARCH comes in. The program has helped us develop a research capacity to truly understand the population we serve. The objective is to make informed decisions about the services we deliver.

"It's not good enough to say we're a small region and don't have the research resources or access to information. Health authorities are autonomous bodies, so it is important to have the skill sets to make these decisions. We have to move in the direction of continuously developing the ability to demonstrate results."

"The program has helped us develop a research capacity to truly understand the population we serve."

And that is exactly what Keeweetinok Lakes has done. In 1996, the region sent health researcher Pam Brockway to the first SEARCH program. Sandra Marini and Muriel Davidson participated in the program in 1998. When the call went out for participants for the third round of SEARCH in 2001, Ms. Wallsten finally had an opportunity to attend. She is enrolled along with Keeweetinok Lakes health researcher Brenda Hahn.

The latest group of SEARCHers has completed the instructional component of the program, which consists of intensive instruction in fundamental research skills. They are now starting their own research projects. Wallsten is part of a group project with Wendy Heffren from the Alberta Mental Health Board and Andrew McDonald from the David Thompson Health Region. The team is studying high-level decision-making; specifically, why some collaborative initiatives are successful and some are not.

"There are an increasing number of inter-ministerial initiatives where health is one of the partners," explains Wallsten. "What are key success factors? Does training or orientation make a difference? What is the best way of working together? We need to find ways to facilitate these collaborative processes, rather than starting at square one each time an inter-sectoral committee is formed."

Daria Wallsten also has an individual project underway—evaluating the planning model adopted by the Keeweetinok Lakes RHA at regionalization. "This model for planning of integrated health services is focused on client outcomes, on making a difference to the people who use our services. We haven't had a chance to validate the model. Are we getting out what we thought we would? That's what I'll be looking at.

"I'm thrilled to have the opportunity to become a SEARCHer," says Wallsten. "Keeweetinok Lakes has already developed a strong research team. In the past two years, we have submitted three project proposals that were successful in obtaining external research funding. That's amazing for a small region. A lot of credit is due to SEARCH for helping us develop our research capacity." rn

ABOVE: DARIA WALLSTEN

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ABOVE: DARIA WALLSTEN

You're just about to step off the curb, when suddenly a car speeds through the red light and heads straight for you. Instantly, you jump back. Your body's response to stress has just saved your life.

Experiencing some stress helps protect us from risks and physical hazards, says Dr. Jaideep Bains, Assistant Professor in the Department of Physiology and Biophysics at the University of Calgary, and a member of the Neuroscience Research Group. Too much stress, however, can interfere with day-to-day activities or even become debilitating; for example, the post-traumatic stress disorder sometimes experienced by soldiers who have been in a war zone.

Everyone who has had a hard day at work or at home with the children knows what stress feels like. Medical scientists, however, still don't understand how the body activates and coordinates its response to stressful events or stimuli. Stress causes our heart rate, blood pressure, respiration, metabolism, and anxiety levels to increase, and our appetite to decrease. It also causes a surge of the hormone adrenaline, which gives us extraordinary energy.

"We know the endpoint—the stress response. We just don't know all the machinery involved in stimulating this response."

"This is an amazing number of responses all to be coordinated at once, in response to what is often a single stimuli," Dr. Bains notes. "We know the endpoint–the stress response. We just don't know all the machinery involved in stimulating this response."

Dr. Bains is investigating how neurons (nerve cells) synchronize the stress response by communicating with one another through neurotransmitters. This is called the synaptic physiology of stress. Chemical messengers are passed across the cells' synapses, the junctions between the end of the axon of one neuron and the dendrites of another neuron. Dendrites are fine nerve branches like those in the fingers that feel the heat from a stove burner, for example. They relay the signal to the cell body, which then through its axon signals a muscle–or tells another cell to tell the muscle–to jerk our hand away from the burner. The synapse is essentially the area where one cell can "talk" to another cell.

Communication among neurons

Dr. Bains focuses on communication among neurons in the paraventricular nucleus (PVN) of the hypothalamus–a part of the brain that controls numerous day-to-day bodily functions. Scientists know that the PVN in the hypothalamus synthesizes and secretes a number of hormones that regulate body growth and metabolism. The PVN also coordinates the release of hormones during stress, either to activate the stress response

Communicati

ng stress

or return the body to homeostasis, its normal balance. PVN-coordinated hormones include oxytocin, which contracts smooth muscle, aiding in uterine contraction during childbirth and milk ejection from the mammary glands. Another PVN hormone, vasopressin, raises blood pressure by contracting smooth muscle in the heart and blood vessels.

Neurons in the PVN also synchronize the release of a hormone called corticotropin releasing factor (CRF). CRF appears to be crucial not only in triggering the stress response, but in returning the body to normal when the stress-inducing stimulus is removed, Dr. Bains says.

Because the PVN is a dense and multi-layered tangle of neurons, making the human brain difficult to study, Dr. Bains and his team examine the region in rats. They administer chemical tracers that cause specific brain neurons to show up in different colours under a fluorescent microscope. They then record electrical activity changes in specific groups of PVN neurons in response to stressors. As they refine these techniques, they hope to pinpoint individual neuron molecules responsible for releasing specific hormones, such as the crucial CRF stress-response regulator. Dr. Bains's work has already shown that nitric oxide, a gas involved in other cell-regulating functions, like dilating smooth muscle cells, is an important intercellular messenger in the brain's PVN.

Once people have experienced a stress-triggering sight or event, seeing it again—or even the thought of it—can elicit the same response.

Repeated stress responses

Once people have experienced a stress-triggering sight or event, seeing it again—or even the thought of it—can elicit the same response. Many people who directly experienced the terrorist attacks of September 11 in New York City or watched them on television now feel a stress response whenever they see an airliner flying near a skyscraper. Dr. Bains explains that this may be an example of plasticity—the brain's neurons resetting themselves, often permanently, to respond more readily to the stimuli that originally triggered the stress. He is looking for physiological evidence of plasticity after exposure to a stressor, and is trying to discover which molecules mediate this change.

Another fundamental question is why the stress response—normally a closed-loop system that resets itself to normal—sometimes fails to reset, as in post-traumatic stress disorder. "Maybe under stressful situations, that negative loop gets circumvented, so you don't have this shut-off mechanism," he says. A stress response that is always "switched on" has been implicated in the development of several neurological ailments, including depression, anxiety, eating disorders, and memory impairment.

Dr. Bains points out that increased understanding of how the stress response is regulated could lead to new drugs that target specific molecules to adjust a malfunctioning system. "I think people are just now starting to understand how important managing stress is, or what the potential complications of constant stress can be," he says.

Dr. Jaideep Bains is a Heritage Scholar who also receives funding from the Canadian Institutes of Health Research.

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Bains JS, Longacher JM, Staley KJ. Reciprocal interactions between CA3 network activity and strength of recurrent collateral synapses. *Nature Neuroscience* 1999; 2(8):720-726.

Bains JS, Ferguson AV. Nitric oxide regulates NMDA-driven GABAergic inputs to type I neurones of the rat paraventricular nucleus. *Journal of Physiology* 1997; 499(3):733-746.

DR. DOUGLAS ZOCHODNE

The discovery of insulin more than 80 years ago has significantly reduced the risks of eye and kidney damage in people with diabetes. But another medical complication of this disease continues to ravage the quality of life of most diabetics. Called diabetic neuropathy, it destroys the peripheral nerves in the feet and hands.

The ravages of

"It's the commonest cause of peripheral nerve damage in the developed world," says Dr. Douglas Zochodne, a Professor in the Department of Clinical Neurosciences at the University of Calgary who is both a researcher and a clinician. "It's also a major contributor to lower-limb amputation—it's a huge problem that needs attention."

Diabetes occurs in two forms: In type 1 diabetes, the beta cells in the pancreas fail to produce insulin, which controls the body's metabolism of glucose. People require daily injections of insulin to regulate their blood sugar levels. In type 2 diabetes, obesity, lack of exercise, poor diet, and genetic inheritance all play contributing roles. Some type 2 diabetics actually have very high blood levels of insulin, but the insulin does not do its job in regulating blood sugar.

Most people with diabetes, whether type 1 or type 2, will get some nerve damage or neuropathy in their peripheral nerves, Dr. Zochodne says.

Most people with diabetes, whether type 1 or type 2, will get some nerve damage or neuropathy in their peripheral nerves, Dr. Zochodne says. Peripheral nerves "connect the spinal cord to muscles, skin, and other organs to control movement and sense things." The first symptoms of damage include numbness, tingling, weakness, and pain in the toes or fingers, as the nerve cells start to degenerate and die. Patients lose feeling in their feet, so they often don't realize when they injure themselves. This in turn leads to infections, which don't heal as readily in diabetics as in non-diabetics.

Dr. Zochodne also sees patients in his clinic who suffer chronic neuropathic pain, which results from partial nerve damage. This chronic pain destroys quality of life and is very difficult to treat, he points out.

Possible causes

Researchers have identified several possible causes for neuropathy, all of which Dr. Zochodne believes play a role in its development. He and his research team are focusing on two of these mechanisms—microangiopathy and trophic molecules.

Studies have shown that in diabetes the blood supply to ganglia—structures that are collections of peripheral nerve cells—is reduced. The blood vessels in ganglia may become narrowed and stiff, a process called microangiopathy. Dr. Zochodne's team studies microangiopathy by measuring the blood flow rate in the tiny arteries of ganglia supporting peripheral nerve cells. Studies suggest that the cells lining the ganglia, the endothelial cells, may not produce sufficient amounts of nitric oxide, a key molecule involved in dilating or expanding blood vessels throughout the body. The high glucose levels

present in diabetes eliminate nitric oxide molecules, resulting in narrowed ganglia blood vessels and reduced blood flow to peripheral nerve cells.

One theory getting a lot of attention centres on a family of "trophic" molecules, also called growth factors because they help nerves grow. Insulin itself, and a chemically related cousin called insulin-like growth factor (IGF-1), are both trophic molecules. In type 2 diabetes, the body still produces lots of insulin but it may not be performing its role as a trophic molecule in supporting nerve cells in ganglia.

Another recently discovered family of molecules, called endothelins, actually constrict blood vessels. "Diabetic nerves are very, very sensitive to constriction by the endothelins, and they actually suffer a lot of damage from exposure to these molecules," says Dr. Zochodne.

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diabetes

Nerve compression injuries

People who have diabetes are also prone to certain kinds of nerve-compression injuries, such as the well-known carpal tunnel syndrome, in which the median nerve running through the wrist becomes squeezed. Diabetics can also get entrapped (pinched) nerves in the elbow, which can lead to weakness and wasting of the hand. While non-diabetics also develop these conditions, diabetics suffer more severe effects and complications. Even when surgeons operate to decompress the nerve, for example, the nerve tissue doesn't regenerate well.

AHFMR also supports a member of Dr. Zochodne's team, James Kennedy, who has developed a mouse model to study diabetic neuropathy and nerve regeneration. Kennedy has used his model for precise, long-term measurements of the time it takes nerves to regenerate in diabetic versus non-diabetic animals, and what types of compression-injuries are involved. He has also found that due to microangiopathy, diabetic nerves don't seem to be able to increase the blood flow in the area of the injury, allowing it to heal properly. Kennedy was diagnosed with type 1 diabetes when he was two years old, and requires four daily injections of insulin to control his blood sugar levels. "It's not like it bothered me, really," he says of his diabetes. "I've done everything that everybody else has done." An understatement, according to Dr. Zochodne, who praises his student's work as exceptional.

Dr. Zochodne hopes that better understanding of diabetic neuropathy and its mechanisms will help develop new drugs to prevent nerve damage by targeting specific signalling molecules in the nerve cell.

Dr. Douglas Zochodne is a Heritage Senior Scholar who also receives funding from the Canadian Institutes of Health Research and the Canadian Diabetes Association.

James Kennedy receives AHFMR funding for his doctoral studies at the University of Calgary.

Selected publications

Zochodne DW, Verge VMK, Cheng C, Sun H, Johnston J. Does diabetes target ganglion neurones? Progressive sensory neurone involvement in long-term experimental diabetes. *Brain* 2001; 124(11):2319-2334.

Kennedy JM, Zochodne DW. The regenerative deficit of peripheral nerves in experimental diabetes: its extent, timing and possible mechanisms. *Brain* 2000; 123(10):2118-2129.

Zochodne DW. Diabetic neuropathies: features and mechanisms. *Brain Pathology* 1999; 9(2):369-391.

IMAGE: MARC HUTCHINSON. *SELF PORTRAIT/VESALIUS #4*. 52.4 X 37.6 CM. 1991. COURTESY OF THE ALBERTA FOUNDATION FOR THE ARTS.

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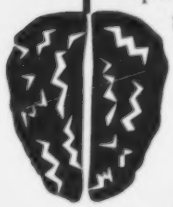
Mapping the brain

Dr. Christian Beaulieu is working on developing advanced MRI techniques for the assessment of stroke, in collaboration with neuroradiologist Dr. Derek Emery and neurologist Dr. Ashfaq Shuaib, the Director of the Division of Neurology and head of the stroke team at the University of Alberta. With the centre's location in the basement of the emergency wing, researchers have access to acutely ill patients—those who have just suffered a stroke or a heart attack, for example—who would not be able to leave the hospital to go to an off-site research facility.

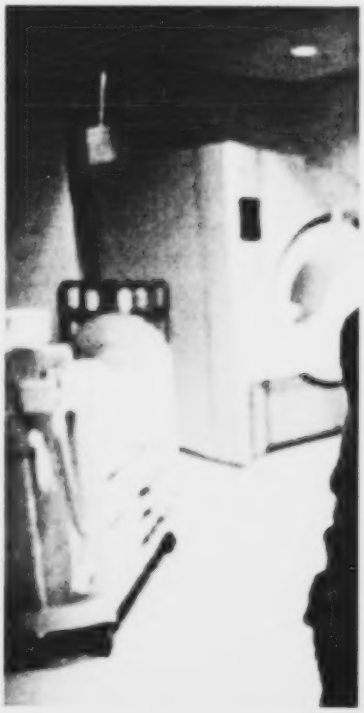
"We are trying to find new uses for current, state-of-the-art MRI methods in acute stroke and working at developing the next generation of MRI techniques," says Dr. Beaulieu. "The hope is also to learn more about the evolution of disease, such as stroke, which will lead to better use of diagnostic imaging and maybe better treatment strategies." He hopes his studies will show that MRI could also be used as a basis for administering clot-busting drugs to stroke patients—so that doctors can look at the MRI scan of the brain rather than the clock as a tool in deciding whether to administer the drugs.



Dr. Beaulieu conducts studies in which he scans a patient multiple times after a stroke. He scans at three different time points in the first 24 hours after onset of stroke (when there is a great deal of evolution in the brain), then again after a week, and again after a month. Until recently, CT scans had been used more frequently to diagnose early stroke patients, partly because MRI scanners were not very accessible due to the high demand for the equipment. CT scans are not very sensitive to early stroke, however, and the MRI is a much more versatile tool.

The NMR facility has MRI scanners of three different strengths: a 1.5 -tesla, a 3-tesla, and a 4.7-tesla magnet. The 4.7-tesla magnet is the strongest one in Canada for human studies, and likely the most expensive piece of equipment in the hospital. For the past three years, Dr. Beaulieu has devoted much of his time helping to design the NMR Centre and get it up and running. In March, he used the facility to scan the first stroke patient, and he expects to scan many more in the next few years. "We also envision that our facility will become a valuable resource for other physicians and scientists interested in using MRI to help unravel the mysteries of human disease," adds Dr. Beaulieu.

In addition to his work with stroke patients, Dr. Beaulieu is one of several investigators across the country working as part of the Canadian Language and Literacy Research Network (CLLRNet) funded by the National Centres of Excellence. The University of Alberta is one of two core facilities for MRI studies within the Canada-wide network. The study involves conducting MRI scans of the brains of children with dyslexia using diffusion tensor MRI, a non-invasive method of mapping the integrity of the white-matter tracts in the brain. The scans will be compared to those of children without dyslexia. "We can use some of the same advanced MRI tech-



"We can use some of the same advanced MRI techniques that we're developing to look at the stroke patients to learn more about something quite different, like dyslexia."

niques that we're developing to look at the stroke patients to learn more about something quite different, like dyslexia," he explains. "There's just so much you can do with MRI, which is what makes it so powerful," says Dr. Beaulieu.

Dr. Christian Beaulieu is a Heritage Scholar and an Assistant Professor in the University of Alberta's Department of Biomedical Engineering. He also receives funding from the Canadian Institutes of Health Research, National Centres of Excellence, Canada Foundation for Innovation, and Alberta Science and Research Authority.

Selected publications

Beaulieu C, de Crespigny A, Tong DC, Moseley ME, Albers GW, Marks, MP. Longitudinal magnetic resonance imaging study of perfusion and diffusion in stroke: Evolution of lesion volume and correlation with clinical outcome. *Annals of Neurology* 1999; 46(4):568-578.

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Mapping molecular structure

"NMR is a powerful tool for understanding molecular structure."

Of course, that's all rather deceptive, because the biological samples are tucked away inside three NMR (nuclear magnetic resonance) machines. NMR is a technique where a sample is placed in a magnetic field and hit with radio waves. The nuclei of the molecules resonate at particular frequencies, which are picked up and decoded. This is a complex process, as the presence of the many computers indicates, but the end result is a three-dimensional image of the molecule.

"NMR is a powerful tool for understanding molecular structure," says Dr. Hans Vogel, a Heritage Medical Scientist and director of the Bio-NMR Centre. "This discovery process—whether using NMR or other techniques—is the driving force for my work. I'm intrigued by the very inventive and elegant ways that nature accomplishes things."

Dr. Vogel's research area is proteins, focusing on calcium-binding proteins. "Calcium is extremely important because every cell tries to pump calcium to the outside or store it inside the cell," he explains. "When the cell becomes activated it releases little puffs of calcium. Proteins respond to this increase in calcium concentration by turning certain things on."

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Calcium-binding proteins regulate many important processes such as blood clotting, smooth-muscle contraction, and motion in skeletal and cardiac muscle. "This is an area where there are a lot of implications for human health," says Dr. Vogel. "What we try to do is understand calcium-binding proteins at a molecular level. This may ultimately lead to other groups being able to design drugs that modify calcium-binding processes."

Dr. Vogel also studies iron-binding proteins that are involved in the uptake and transport of iron. "Iron is an essential element to almost all forms of living matter," he explains. "The problem with iron is that it is quite insoluble, so nature has devised all kinds of ingenious ways to get at it."

Superbugs also figure prominently in another of Dr. Vogel's research programs.

For example, some bacteria make compounds called siderophores that bind iron outside the cell extremely tightly. The siderophore is then pumped back into the cell and the iron is freed up.

"People have come up with the idea of piggybacking an antibiotic onto a siderophore, making a Trojan horse," notes Dr. Vogel. "In fact, there is this smart fungal strain that already makes a siderophore with an antibiotic attached to it. The bacteria pumps the whole thing in, there is an enzyme that cuts off the antibiotic portion, and the bacteria dies.

"This could be a way to go after superbugs, bacteria that are resistant to normal antibiotics. You could exploit the bacteria's own devices for pumping in iron and other metal ions."

Superbugs also figure prominently in another of Dr. Vogel's research programs. He is studying antimicrobial peptides, tiny fragments of proteins that kill bacteria and are potential substitutes for antibiotics. In 1990, only about 5 antimicrobial peptides were known to exist. Now scientists are working with more than 500.

"Our work on antimicrobial peptides is basic science," explains Dr. Vogel. "We're trying to see how these peptides work, what they look like, how they get across the cell membrane. Hopefully, somewhere in there we can find the nugget to generate new types of antibiotic compounds."

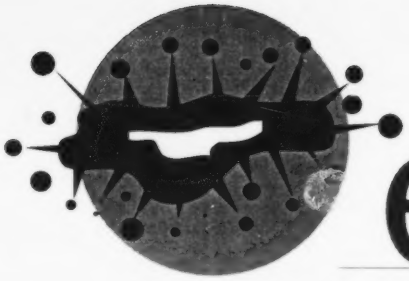
NMR is ideally suited for this work, because it allows for the study of interactions between peptides and cell membranes. The University of Calgary's Bio-NMR Centre now has three NMR machines, including one purchased with AHFMR funding 16 years ago to kick-start Dr. Vogel's research. This machine was recently upgraded, as was another NMR bought in 1989. The upgrade to the second NMR included the installation of a cryoprobe—an instrument used to apply extreme cold to tissue—making this instrument the most sensitive NMR in Canada.

The centrepiece of the Calgary NMR facility is a powerful 700 MHz NMR, purchased in 2001 with $3.3 million in public- and private-sector funding. "We now have a state-of-the-art NMR centre here," says Dr. Vogel. "Combined with the National High Field NMR Centre (NANUC) at the University of Alberta, Alberta has an impressive capability for NMR research."

Dr. Hans Vogel is a Heritage Medical Scientist and a Professor in the Department of Biological Sciences, University of Calgary. His research is also supported by the Alberta Heart and Stroke Foundation, Canadian Institutes of Health Research and the Natural Sciences and Engineering Research Council. The infrastructure upgrade to the Bio-NMR Centre was funded by the Canada Foundation for Innovation, Alberta Science and Research Authority, AHFMR and Alberta's Intellectual Infrastructure Partnership Program.

Recent publication

Calcium-Binding Protein Protocols, vol. 1 and 2. Vogel HJ, ed. *Methods in Molecular Biology* (series), vol. 172 and 173. Totowa, NJ: Humana Press, 2002.



The fix-it enzymes

Millions of cells in the human body perform a constant "search and repair" operation to keep us healthy and protected against diseases. But sometimes, a cell's delicately balanced internal repair mechanisms can go awry and cause all sorts of problems, says Heritage Scientist Dr. Susan Lees-Miller. "What we're really interested in is how, at the molecular level, cells detect and repair DNA damage induced by ionizing radiation and by oxygen free radicals."

Ionizing radiation is employed in radiation therapy to destroy the DNA, the genetic blueprint inside cancer cells. The radiation penetrates cells, releasing chemically reactive oxygen molecules (oxygen free radicals), a process called oxidation that damages and kills cells.

A major type of DNA damage that occurs within a cell is a "double-strand" break, a cut in both strands of the twisted, double-helix DNA molecule. "That's the most lethal form of radiation damage you can get, because it breaks the DNA in half and [the cell] has to put those ends back together," Dr. Lees-Miller explains.

She and her research team focus on two protein kinases, also known as enzymes, that direct chemical reactions within a cell. These enzymes, called DNA-PK and ATM, are constantly detecting and repairing double-strand breaks in the DNA. "If these enzymes go wrong, there's no surveillance. So the DNA damage is going to increase and lead to all sorts of problems," Dr. Lees-Miller notes.

In laboratory animals, cells without DNA-PK or its related components can't make mature, disease-fighting immune cells. These animals have a life-threatening condition called severe combined immunodeficiency (SCID), which can also occur through various genetic mutations in mice, dogs, horses, and people.

ABOVE: DR. SUSAN LEES-MILLER

The other enzyme, ATM, plays a pivotal role in signalling to a key DNA-guarding molecule called p53. The p53 molecule tells the cell whether it should put its activities—including reproduction—on hold temporarily while damage is repaired, or whether the damage is too great and the cell should die. Significantly, a mutated form of p53 has been found in at least 50 per cent of all human cancers, including breast tumour cells. "They don't have a mechanism to tell them 'There's too much damage—kill this cell,'" says Dr. Lees-Miller. Also, children who inherit two mutated ATM genes, one from each parent, suffer from a rare and usually fatal immune-deficiency disease called *ataxia-telangiectasia* (A-T).

Better understanding of how DNA-PK and ATM perform their DNA-repair jobs could lead to selective cancer treatments that cause fewer side effects than radiation and chemotherapy. New drugs might switch off the repair functions of DNA-PK and ATM for DNA in tumour cells only, thereby stopping them from reproducing.

Dr. Lees-Miller is a Heritage Scientist, and a Professor in the Department of Biochemistry and Molecular Biology at the University of Calgary, with a joint appointment in Biological Sciences. *She also receives funding from the National Cancer Institute of Canada, the Canadian Institutes of Health Research, and the Alberta Cancer Board.*

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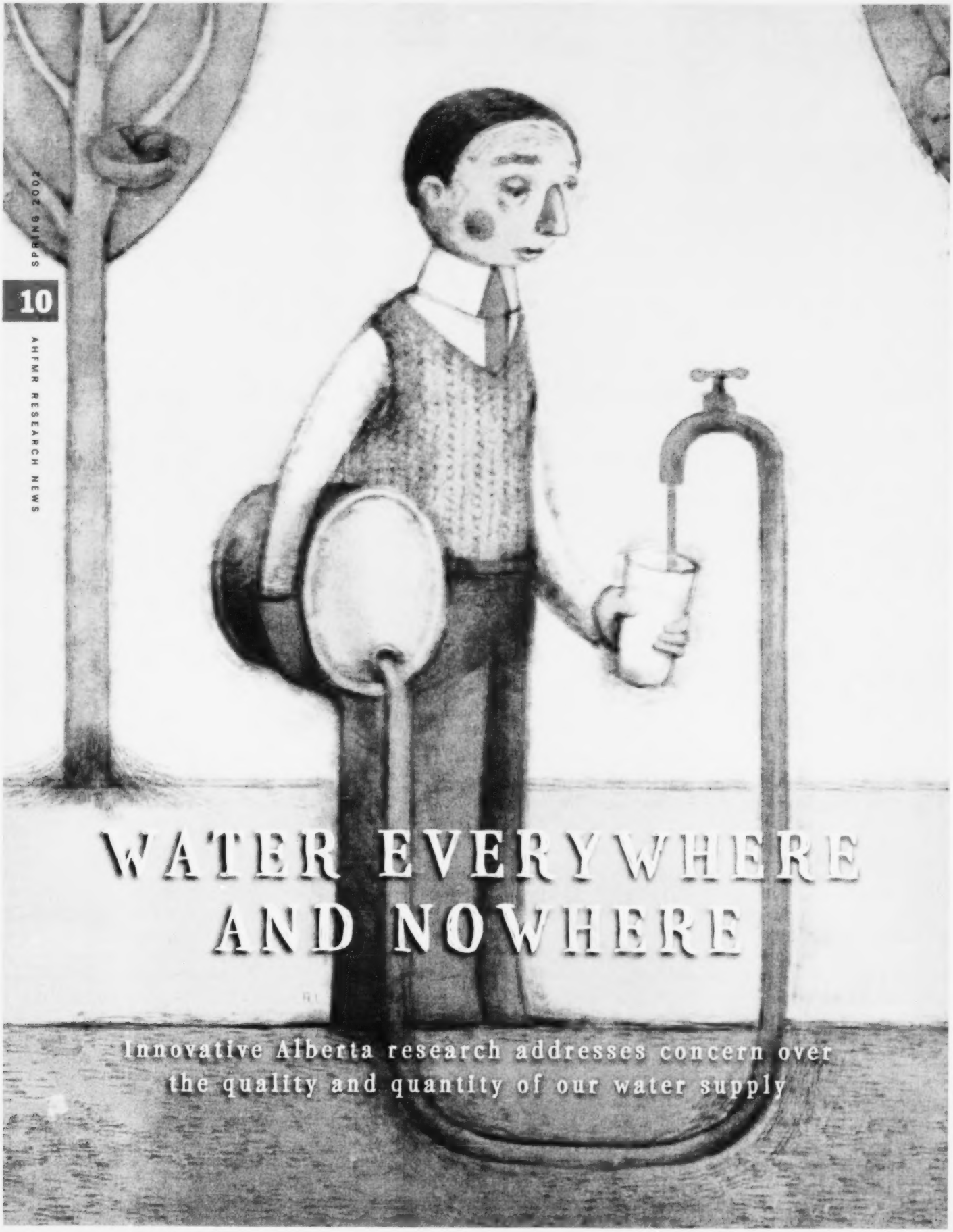

WATER EVERYWHERE AND NOWHERE

Innovative Alberta research addresses concern over the quality and quantity of our water supply

We drink it, we cook with it, and we bathe in it. Water is essential to human survival; without it we would live less than a week. North Americans are vast consumers of H_2O. We devour it as though there were an everlasting supply. We saturate our lawns with it, endlessly run it through our dishwashers and washing machines, and use it to keep our cars and driveways sparkling. With an average person using over 300 litres of water a day, there is seemingly no end in sight to the demand for fresh, clean water.

Benjamin Franklin once said, "When wells dry, we know the worth of water." Scientists in Alberta are again warning that our wasteful ways need to change—fast. Mild winters and a lack of snow cover in the south of the province have left fields and mountaintops bare and dry, sparking fears of continued drought and a shortage of drinking water. A lack of water economy and recent questionable water treatment practices are adding to the concern about our dwindling water supply.

In Alberta, multiple water issues are garnering attention. In the south, unusually temperate conditions have left the Oldman River Dam virtually empty. Irrigation canals used to water arid land on which 40% of the province's cash food crops grow, are also drying up. Fields normally snow-covered in February are brown, leaving farmers to look elsewhere for relief from their water woes; the viability of exporting water from northern Alberta to its southern borders is one solution being explored. Across the province, there is concern over the possibility that effluent from intensive livestock operations may be contaminating some drinking water supplies and that high levels of arsenic found in groundwater wells may be affecting the health of some rural families.

With the highest percentage of irrigated land in Canada, the Lethbridge area has a keen interest in good water management. So much so, that the University of Lethbridge has collaborated with federal, provincial, academic, and private-sector partners to establish an institute dedicated to researching water issues. The Water Institute for Semi-arid Ecosystems (WISE) is the single biggest investment in research the University has ever made, says Dr. Dennis Fitzpatrick, the administra-

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tor overseeing the initiative. In fact, four of the University's major research chairs will be devoted to WISE. "Southern Alberta depends on water flow from the snowpack in the mountains to provide us with our drinking water and to fill the canals we use to irrigate our crops," he explains. "That's why it's so important to have WISE here. In these semi-arid conditions, water is a precious resource that we need to treat like gold."

Environmental concerns related to manure on fields have gained recent prominence with Ontario's Walkerton water tragedy. Despite following model farm practices, cattle manure from a small farm operation seeped into the town's drinking water supply, tainting it following a severe rainstorm. That incident, combined with poor water management practices by town officials, led to the deaths of seven people and caused 2,300 town residents to fall ill.

Dr. Steve Hrudey is a member of the research advisory panel that provided input into the Walkerton inquiry report. The University of Alberta scientist also serves on Alberta's Environmental Appeal Board (AEAB). One of the first hearings he judged involved a government approval to relocate a water intake pipe. The utility company had permission to move it to one foot away from a rancher's property line. The rancher pointed out to the Board that the pipe was collecting drainage from his pasture, and the Board recommended to the Minister of the Environment that the approval be revoked. The company was eventually ordered to relocate the pipe. "This rancher may have saved us from our own Walkerton," Dr. Hrudey notes.

Although Alberta was the first province in Canada to adopt as regulation the Guidelines for Canadian Drinking Water Quality, stories like these prompt the environmental health specialist to issue a stern warning. "Our province has some of the highest standards for water in Canada but there is still a need for vigilance," he says. "We can't be complacent about regulation. That's the biggest lesson we can learn from Walkerton."

When the second part of the Walkerton inquiry report is released this spring, it is expected to address the need for major restructuring of the management of Ontario's drinking water. The report will be drawn up with input from Edmonton and Calgary water experts—some of the best in the country.

An increase in blue-green algae blooms, generally attributed to the chemicals in agricultural runoff, may also pose a serious threat to communities that use raw and untreated drinking water. Frequent blooms in the heat of summer increase the likelihood that liver toxins called microcystins will be present in the water supply. However, not all blue-green algae blooms produce toxins. Where toxins are present, the amount varies dramatically within the body of water and over time. Health problems associated with the toxins include liver problems, tumour promotion, and skin irritation.

While most communities in Canada meet or exceed the minimum standards for water purity, Dr. Charles Holmes has discovered that the drinking water used by at least one First Nations community in northern Alberta may be unsafe to drink. Last summer, using a prototype field kit he had developed, he tested water from Sturgeon Lake—the source from which the neighbouring Sturgeon Lake Cree Nations community draws its untreated water supply. The results were dramatic. "Within thirty minutes we had a positive test for microcystins," he says. His findings were relayed to community officials, who are now working with Dr. Holmes to address their water quality concerns.

ABOVE: DR. STEVE HRUDEY

With his field-test kit now approved by Health Canada, he is working to identify the molecular mechanisms that underlie the toxin. Dr. Holmes hopes to draw attention to the safety of the drinking water in some rural communities. However, his efforts are stymied, for now, by a lack of funding to commercialize the kit and further his research in this area. "It's a novel project with the potential for impacting the health of Canadians, but no research agency currently has a slot into which this kind of work falls," he explains.

Arsenic contamination is another worldwide water concern; millions of people are affected every year. Exposure to high levels of naturally occurring arsenic in well water may lead to such serious health problems as lung, skin, and bladder cancers, high blood pressure, and even diabetes. It's a silent threat of which many people are unaware. Arsenic is colourless, odourless, and tasteless, and the length of time and amount of exposure may determine its health effects.

High levels of arsenic contamination are particularly prevalent in Third World countries. In a horrible irony, UNICEF and the World Bank started to build tube wells in India and Bangladesh in the 1960s to provide residents with clean drinking water. While they reduced the problem of the microbial diseases in water that killed thousands of children a year, a new danger lurked. It wasn't until the 1980s that symptoms of arsenic poisoning began showing up in residents. It was originally thought that leprosy was the cause of the disfiguring lesions from which many people were suffering. In fact, the cause was arsenic, which is naturally present in the rock and soil. While the UNICEF workers had lessened the problem of microbial disease, no one had thought to test the water for the arsenic, which had leached into the well from the rock.

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Within Canada, problems related to arsenic are less common and far less severe. The surface water the majority of our population consumes is rigorously tested and complies with safety guidelines. The relatively small population of people in rural areas who drink well water may be at some risk, depending on their local arsenic levels. In this province, Alberta Health and Wellness has collaborated with regional health authorities and the University of Alberta to test for arsenic in some rural wells and notify residents if levels are high.

However small, the risk is real. Residents of a Newfoundland community near St. John's recently discovered that their drinking water contained traces of arsenic 12 times higher than Canadian guidelines.

Scientists still don't know how arsenic causes cancer and whether low-level exposure to arsenic can cause health problems. It's a challenging topic to study. Because animals process arsenic differently than humans, there are no reliable animal models on which to test the effects of arsenic on the body. Analytical chemist Dr. Chris Le and his colleague Dr. Michael Weinfeld, a biochemist at the Cross Cancer Institute in Edmonton, have developed new approaches to understanding arsenic health problems. They have developed state-of-the-art techniques to detect trace levels of arsenic and metabolites in humans and to measure arsenic effects on DNA. Scientists on their team study how arsenic metabolizes in the body and how it affects the cellular machinery that repairs DNA damage in human cells.

Ridding drinking water supplies of arsenic and other contaminants comes with a high financial cost. "There is a huge industry built around removing arsenic from drinking water," says Dr. Le. "In the United States alone, the cost for complying with water safety regulations runs between five and fifteen billion dollars per year for arsenic alone." But putting financial considerations above human health can come with its own costs. **Page 14 ▸**

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BOTTOM: DR. CHRIS LE (L) AND DR. MICHAEL WEINFELD (R)

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Dr. Dennis Fitzpatrick is a Professor of Biochemistry, the Associate Vice President (Research) at the University of Lethbridge, and interim chair of the Water Institute for Semi-arid Ecosystems (WISE) Board. Partners in WISE include the University of Lethbridge, Alberta Agriculture, Food and Rural Development, Health Canada, the Canadian Food Inspection Agency, the Alberta Irrigation Projects Association, Agriculture and Agri-Food Canada, the Chinook Health Regional Authority, Alberta Environment, and the Alberta Research Council.

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Recent publication

Hrudey SE, Huck PM, Payment P, Gillham RW, Hrudey EJ. A fatal waterborne disease epidemic in Walkerton, Ontario: Comparison with previous waterborne outbreaks in the developed world. In: *Proceedings of the 11th International Water Association Symposium on Health-Related Water Microbiology*, held in Melbourne, Australia, April 8, 2002.

Dr. Charles Holmes is a Heritage Scientist and an Associate Professor in the Department of Biochemistry in the Faculty of Medicine and Dentistry at the University of Alberta.

Selected publication

Bagu J, Sonnichsen F, Williams D, Anderson R, Holmes CFB. Comparison of the solution structures of microcystin-LR and motuporin. *Nature Structural Biology* 1995; 2:114-116.

Dr. Chris Le is a recipient of Heritage Technology Commercialization funding. He is an Associate Professor and Canada Research Chair in the Department of Public Health Sciences and an Adjunct Professor in the Department of Chemistry and the Department of Laboratory Medicine and Pathology at the University of Alberta. He receives additional support from Alberta Health and Wellness, the Awwa (American Water Works Association) Research Foundation, the National Cancer Institute, the National Institutes of Health, the Natural Sciences and Engineering Research Council, the Canada Research Chairs Program, Canadian Water Network (National Centres of Excellence), and the US Environmental Protection Agency.

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Unhealthy working conditions

Farming. The word evokes images of golden wheat fields and chocolate-brown earth. To most of us, it's the epitome of healthy living. But many farmers may be putting their health in jeopardy when they spray their crops with pesticides to protect against insects or weeds, and coat their fields with chemicals to boost plant growth.

There are studies galore about what pesticides on food can do to the health of those that consume it. Now an Edmonton occupational health researcher is studying the long-term health effects of exposure to chemicals on the farmers who use them. Dr. Nicola Cherry has begun a study of long-time grain farmers to see whether those who use pesticides have more health problems than farmers who don't, and to find out if their attitudes toward pesticide use have changed over the years. The two-year Health Research Fund study is a follow-up to a study conducted by Alberta Agriculture 15 years ago.

In a similar previous study of English sheep farmers, Dr. Cherry found that their genetic makeup made some farmers more susceptible to chemicals in pesticides. "While most people can detoxify these organophosphates, people with a less effective gene became ill from the chemicals," she notes. Her results were published in the prestigious scientific journal *The Lancet*.

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ABOVE: DR. NICOLA CHERRY
FAR RIGHT: PROFESSOR TANG LEE

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When judges and support staff at the Alberta Court of Appeal building in downtown Calgary began experiencing unexplainable symptoms such as fatigue, respiratory illnesses, and eye, ear, and nose irritation, they started to wonder if the historic building they were working in was somehow the cause of their multiple health complaints.

At one point an outdoor air intake system was installed in the building to improve its indoor air quality. Staff began to feel better within the first two days of the system's operation, but on the third day many of them mysteriously fell ill again. Enter Professor Tang Lee, an architect specializing in the health of buildings, who was called in to take air samples. His test results confirmed high levels of a toxic microbe growing as a mould throughout the building. He recommended the building be shut down until the toxin could be removed.

Because the building's new air-intake system was not balanced with an exhaust system, the inside air became warm and moist. As a result, condensation formed on the sandstone walls, making them damp and eventually mouldy. The microbes in the mould took three days to grow and release the toxic spores that made staff sick.

Further examination of the building revealed the insidious nature of the microbes. They were found to be growing in the fabric and leather furniture and, most alarmingly, in the books and files of the Court of Appeal. Not realizing the seriousness of the problem, some of the judges had taken files home to work on, and in the process spread the spores to their homes.

While it is relatively easy to destroy this kind of mould with chlorine bleach or other disinfectants, it is almost impossible to get rid of it entirely without removing or damaging the materials into which it has seeped.

Professor Lee has spent nearly a year trying to find the judges and their staff a healthier place to work. After combing the city, he has finally found them new office space. Even though it is relatively healthy, the new work environment will still need to be modified before anyone can move in. Hardwood, cork, or tile flooring will be installed because carpet, which is made of petrochemical products, off-gasses dyes and other chemicals used in its production.

Off-gassing from photocopiers and laser printers is also a concern in the workplace. These seemingly innocuous office machines must be used in well-ventilated spaces because several hundred chemicals are emitted in the process of burning toner onto paper. In the judges' offices these machines will need to be vented through exhaust fans.

Special furniture is also being made for staff. A Calgary company is designing furniture made with natural materials such as wood, glass, and metal, and will use special glue and other construction material that does not off-gas as fabric, leather, or other materials would do.

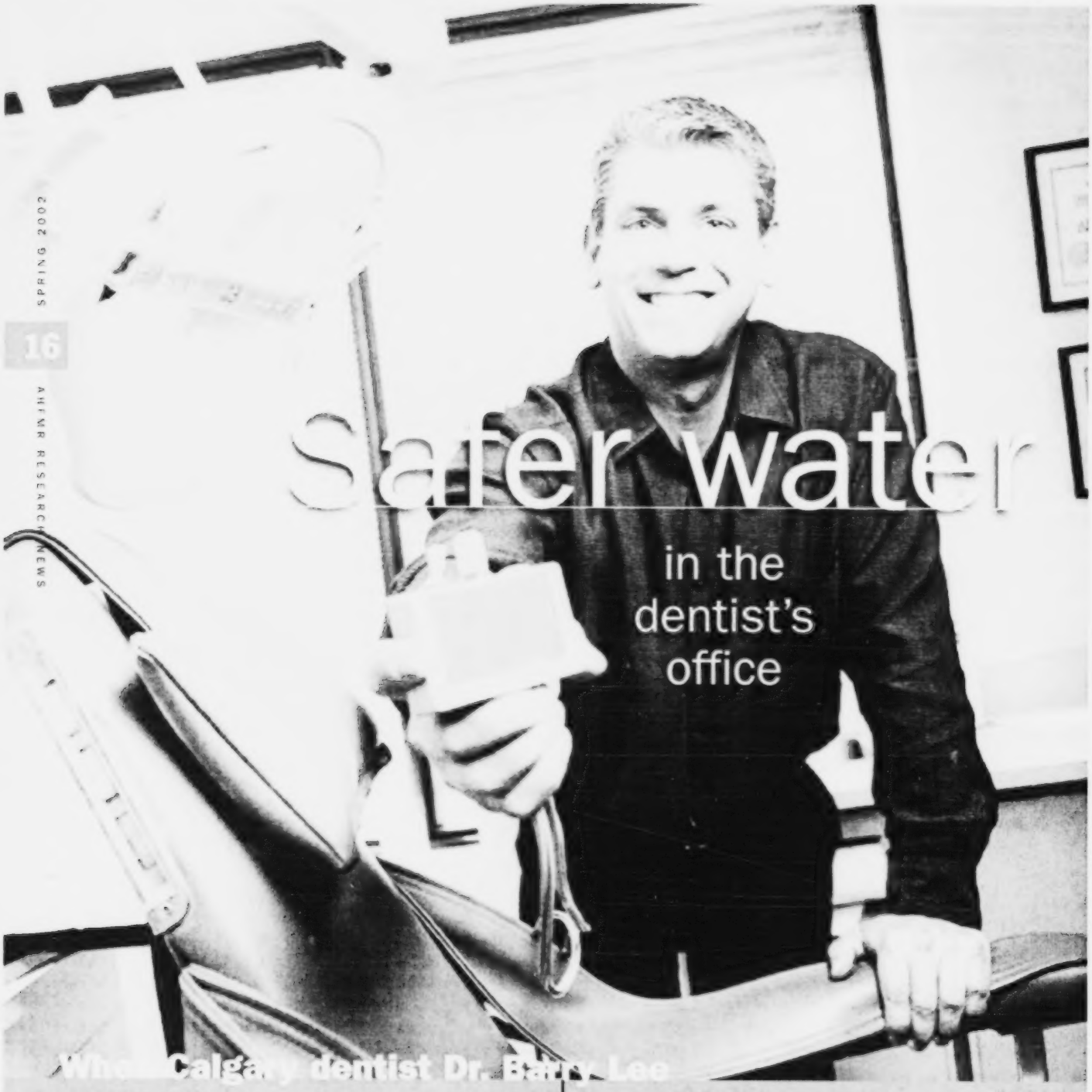
While he's found them a place to work, Professor Lee is still struggling with how to salvage the judges' books and files. He's developed a new technique using UV and disinfectant gases that he hopes will zap the spores. In the meantime, the judges are scanning the contaminated hard copies into electronic files and in the future may have to view their files and books from inside a fume hood.

Professor Tang Lee is a Professor of Architecture in the Faculty of Environmental Design at the University of Calgary.

Upcoming publication

Lee TG, Stooke T. Mould propagation resulting from air pressure differences across the building envelope. In: *Proceedings of the 9th International Conference on Indoor Air Quality and Climate*. Indoor Air 2002; Monterey, California; June 30 to July 5.

Safer water in the dentist's office



When Calgary dentist Dr. Barry Lee

travel like a US television newsmagazine show a couple of years ago, he expected to be entertained. Instead, he was horrified by a report on bacterial contamination in dental water lines. The show's investigation revealed startling levels of bacteria—almost 90% of the water sampled from dental water lines failed to meet federal drinking water standards.

"I was shocked by those results," says Dr. Lee. "We flush our lines, we disinfect them, but so did the dentist offices in the TV report. Although I've never had a patient get sick from the water, I wanted to be proactive. I wanted to be able to deliver a safe system."

ABOVE: GORDON DAY

So did Gordon Day and Neil Stewart, two Calgary dental equipment technicians whose job is fixing dental equipment. They had been called in many times to flush out lines totally plugged with bacterial buildup and fix equipment damaged by the corrosive effects of some of the chemicals used to kill bacteria.

"It was obvious to us that the problem lies in the design of the water lines that feed dental tools," says Day. The water-line tubing is very narrow and water can easily stagnate inside it. This creates the perfect environment for the growth of biofilms, slimy coatings of microbes that attach to underwater surfaces. Biofilms resist flushing and chemical treatment.

Stewart, who has invented a number of devices for the dental industry, started thinking about the problem. He developed a seamless flow system—a patented control valve and a single piece of tubing that streamlines the system. It does not replace the need for flushing and disinfecting, but it makes these processes much more effective.

"It's a simple design, and that's why it works," says Stewart. "There are no dead ends or branches, and it takes 15 seconds to flush the system. When you want to put in new tubing, there is only one piece of tubing to replace."

Developing commercial potential

Day and Stewart realized there was commercial potential to their system, which they named SV3, but they needed help to develop it. Industrial Technology Advisor Robin Black, from the National Research Council's Industrial Research Assistance Program (IRAP), directed them to AHFMR's Technology Commercialization (TC) Program.

"We were a little intimidated at our first meeting," recalls Day. "We looked at some of the other TC projects ... people were working on things like regenerating nerve cells. We seemed like a couple of amateurs with a valve."

But TC funding is not only for AHFMR scientists intent on commercializing their research, notes Rick Brommeland, an Edmonton-based management and technology consultant who is one of the advisors to the TC Program. "TC funding assists Alberta-based innovators with the transfer of new health-related ideas and scientific findings into successful commercial products and services," he explains.

TC funding is not only for AHFMR scientists intent on commercializing their research.

"In Gord Day and Neil Stewart, we saw two very committed individuals who are passionate about making dental water lines hygienic. We knew where TC funding could help."

Day and Stewart's company, Flexcorp Inc., was successful with two TC applications. The first helped fund engineering and reliability tests on the valve, which were carried out at the Alberta Research Council. The second project, recently completed, entailed a small clinical trial to test the effectiveness of the SV3 system. Results are being analyzed by the Biofilm Research Group at the University of Calgary.

"The TC funding was very important to us," says Stewart. "We realized that to move our product ahead we had to have data from independent testing. It would have been difficult for us to find the expertise AHFMR connected us with."

Flexcorp's SV3 system has already been installed in about 20% of Calgary dental offices, including Dr. Barry Lee's. "The conventional wisdom is that high bacterial levels are only a possible danger to people with compromised immune systems," says Dr. Lee. "However, I have peace of mind knowing that our counts are safe for everyone."

Growing awareness boosting business

Flexcorp's business has been boosted by a growing awareness of contamination in dental water lines. In 1996, the American Dental Association established a goal for the dental industry to reduce bacterial counts in water used for dental treatment to fewer than 200 colony forming units (CFU) of bacteria per millilitre of water by the year 2000. (This goal is consistent with the standard for water used in kidney dialysis.) Standards for drinking water in Canada and the US are a maximum of 500 CFU/mL. Day notes that variables in existing water-line plumbing in dental units make consistently good water quality difficult to attain. Flexcorp's SV3 system eliminates these variables.

The challenge for Flexcorp now is to expand the business. Both Day and Stewart have kept their jobs, leaving little time for marketing. To date, the two have manufactured all the units themselves.

"We know we have to put more time and effort into marketing, and that probably means finding investors so we have the resources to expand," says Stewart. "We are ready for commercialization."

Flexcorp's SV3 system has already been installed in about 20% of Calgary dental offices.

After leaving school at age 16, Heritage researcher Dr. Diane Taylor took a look at her limited career options. "At that time, in 1964 in England, very few people went to university," she says. "I could have taken teacher training, but didn't want to. I went to work in a hospital lab instead."

The secret life of bacteria

Now a worldwide authority on bacterial genetics and Professor in the Department of Medical Microbiology and Immunology at the University of Alberta, Taylor smiles when she thinks about her unconventional career path. "It took me a while to get going, but once I started, I didn't stop."

The hospital job, and a subsequent job at a university lab in Belfast, fuelled Taylor's interest in science. When she and her husband moved to Toronto in 1967, she decided to enroll in university. But without Grade 13 equivalency, she had to complete a year of high school first. Once on the academic track, though, Taylor was on a roll, completing her Ph.D. in a very quick three years.

She started work at Toronto's Sick Children's Hospital, and almost immediately began studying the bacteria *Campylobacter jejuni*, the most common bacterial cause of diarrheal illness in North America. Most cases of *campylobacteriosis* are associated with handling raw poultry or eating raw or undercooked poultry meat.

At the time, Taylor's interest was in how *Campylobacter* acquired resistance to the antibiotic tetracycline. "In the lab, we saw many bacteria that were tetracycline-resistant," she says. "I wanted to understand how they became resistant to an antibiotic they'd never encountered before."

The research team found that the key was an exchange of plasmids, tiny loops of DNA that often carry genes which impart some advantage to the cell, such as resistance to antibiotics. When bacteria contact one another, plasmids can jump out of the bacterial DNA and pass from one cell to the other.

Aggressive infections

Taylor's work on plasmids in *Campylobacter* has recently branched out from antibiotic resistance. She is following up on studies showing that plasmids play a role in how aggressive *Campylobacter* infections are.

"Most people who get *campylobacteriosis* recover completely within two to five days," explains Taylor. "But there are rare, severe *Campylobacter* infections, which result in long-term consequences such as arthritis and Guillain-Barré syndrome." This latter neurological condition can lead to paralysis that lasts several weeks and usually requires intensive care.

Approximately 1 in every 1000 reported *campylobacteriosis* cases leads to Guillain-Barré syndrome. As many as 40% of Guillain-Barré syndrome cases in North America may be triggered by *campylobacteriosis*.

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"If we can show that one strain is more virulent than others and causes these severe infections, it may be possible devise a test to identify this strain."

to identify this strain," notes Taylor. "Doctors could then aggressively treat people who have this strain to prevent severe complications. We're in the midst of this research right now."

Taylor's other major research interest is the bacteria *Helicobacter pylori*, which she began studying soon after arriving at the University of Alberta in 1981. These bacteria can live in the stomach lining, and in 1982 were first implicated in the development of ulcers. Until then, ulcers were believed to be related to stress, diet, and excess secretions of gastric acid. The relationship between *H. pylori* and ulcers was hotly disputed when it was first demonstrated by Australian researchers Drs. Barry Marshall and Robin Warren. "Initially I had reservations about this, too," recalls Taylor. "As a scientist, you're trained to be skeptical. But evidence soon mounted. My research team at the U of A was one of the first groups in North America to duplicate Marshall's findings."

Taylor's most recent work with *H. pylori* involves a case of "molecular mimicry". Some strains of the bacteria have substances on their surface (called antigens) which mimic the surface of the stomach lining. "We're trying to understand why the bacteria goes to the trouble of doing this," says Taylor. There are a number of possible explanations. It could be that mimicking the stomach lining makes it easier for the bacteria to attach. Or it could be that looking like a human cell confers some kind of immune protection.

"We know that not all people with *H. pylori* infections get ulcers," adds Taylor. "It may be that bacteria that don't resemble the stomach lining are the ones that don't cause problems. We just don't know."

"Personally, what drives my research is the thrill of seeing something happening in the lab and investigating it. Finding patterns, figuring out what's going on, pushing along the forefront of knowledge...that's where the excitement comes from."

Antibiotic resistance

But why worry about this, since there is already a treatment that eradicates *H. pylori* and thereby cures or prevents ulcers? It comes back to antibiotic resistance. "Ulcer therapy includes treatment with two antibiotics, and resistance to one of them, clarithromycin, is rising," notes Taylor. "So it makes good sense to look at other strategies to combat *H. pylori* infections." Her lab has already worked with a U.S. company to test an ulcer therapy that blocked the attachment of *H. pylori* to the stomach lining. The treatment worked in the lab, but was a failure in clinical trials.

Although the company is no longer interested in curing *H. pylori*, it found that enzymes produced by the bacteria can mimic human enzymes. The company is now investigating whether these enzymes can be used to make drugs. "This is a good example of how in science you can start off doing one thing, and end up doing something completely different," says Taylor.

"We still have an academic interest in the *H. pylori* antigens. There may be no short-term results, which would have commercial interest, but understanding the molecular biology of these bacteria will have long-term value. If we had to rely totally on funding from companies, this long-term work would not be done.

"Personally, what drives my research is the thrill of seeing something happening in the lab and investigating it. Finding patterns, figuring out what's going on, pushing along the forefront of knowledge ...that's where the excitement comes from.

"Even now that I'm at the stage of my career where I don't do my own lab work, I still get the excitement from students' work. And there's something else now—pride. "I get great pleasure and take great pride in knowing what my former students are doing and seeing their success. I'm sad when they leave my lab, but I can follow their careers. For me, that's a real bonus of this job."

DR. DIANE TAYLOR

Dr. Diane Taylor is an AHFMR Scientist who also receives support from the Canadian Institutes of Health Research, Natural Sciences and Engineering Research Council, and the Canadian Bacterial Diseases Network, a Networks of Centres of Excellence program.

Selected publication

Wang G, Ge Z, Rasko DA, Taylor DE. Lewis antigens in *Helicobacter pylori*: biosynthesis and phase variation. *Molecular Microbiology* 2000; 36(6):1187-1196.

Joined by science

Sin Urban and Rosanna Baker tell people it was science that brought them together. The young married couple met as AHFMR students when both were working in the lab of Heritage Scientist Dr. Linda Reha-Krantz. "I was actually the teaching assistant for a course Sin was taking at one point," says Rosanna with a smile.

Today, with their children Joshua and Zachary, both Sin and Rosanna are continuing their research work in England at the University of Cambridge. Sin has recently completed his Ph.D. in molecular biology, while Rosanna works as a research assistant in the Structural Studies Division of the MRC Laboratory of Molecular Biology. Through a combination of careful career planning, luck, and perhaps kismet, the two work one floor apart in the same building in Cambridge–a crucial factor with children in the picture. "If I have to leave to pick the kids up, Sin can continue any work of mine that needs to be done, because we use similar techniques," explains Rosanna.

The work to which Rosanna refers involves shooting highly focused x-rays at crystallized proteins to determine what they look like. She used this knowledge, combined with protein biochemistry, to study how proteins travel back and forth between the nucleus and the rest of the cell.

For his Ph.D., Sin has been investigating how cells communicate with one another by studying *Drosophila*, the common fruit fly. The chemical signals used by fruit fly cells are the same ones used by human cells. Unlike fruit flies, however, when something goes wrong in the cell-signalling pathways in humans, it tends to lead to cancer. Specifically, Sin has focused on the cell actually sending the signal–how it knows when to send the signal, how it activates the signal, and other such mysteries.

"We adore Cambridge," says Sin when asked what the future holds for the young family. "The department here has won ten Nobel prizes. The structure of DNA and proteins were mapped out here. It is so awe-inspiring to study something in a textbook and then find yourself eating lunch next to the people who did these things." Having completed his Ph.D., Sin has accepted his first academic appointment as a Christ's College Fellow of Cambridge University, and plans to continue his current work on cell signalling for another year and a half. After that, hope-

ABOVE: ROSANNA BAKER (L) HOLDING ZACHARY AND SIN URBAN WITH JOSHUA

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Both Sin and Rosanna recognize the importance of having a spouse who understands the challenges of a demanding research career.

fully a professorship and the start-up of his own lab.

Rosanna is focussed on doing research right now, but is looking into pursuing what many British universities refer to as a "Ph.D. by Publication". This would involve submitting and defending a body of published work compiled while in the workforce, rather than having to enroll in a university program. Since successful candidates tend to be people who have been doing research constantly for about ten years, she realizes she has a few years to go. "I really enjoyed my teaching duties when I was a grad student, so I want to get my Ph.D. at some point–so I can teach," says Rosanna.

Both Sin and Rosanna recognize the importance of having a spouse who understands the challenges of a demanding research career. When one must spend long hours in the lab or prepare for a presentation at a conference, the other is there to look after the boys. There are limits to that understanding, however. "I was still at the lab in Edmonton an hour before our flight when we first moved to Cambridge–Rosanna almost divorced me over that one," remembers Sin. "Science ends up being more an obsession than a career. But this marriage could not have worked if we weren't both obsessed."

Rosanna Baker and Sin Urban are former AHFMR Students. Sin now receives funding from the National Sciences and Engineering Research Council of Canada and from Trinity College Cambridge. He is also the recipient of the Max Perutz Student Prize for Outstanding Research and the University of Oxford Rolleston Memorial Prize 2001 for original research (on hepatitis B virus).

Recent publications

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University of Alberta Department of Public Health Sciences
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The Walkerton Inquiry
http://www.walkertoninquiry.com

Environmental Appeal Board
http://www3.gov.ab.ca/eab/board.html

Health Canada
http://www.hc-sc.gc.ca/English/

Dr. Chris Le's web page
http://www.ualberta.ca/~envrisk/chrispage.html

Unhealthy working conditions

University of Alberta Occupational Health Program
http://www.phs.ualberta.ca/OHP%20Website%20Files/index.htm

When work makes you sick

United States Environmental Protection Agency
http://www.epa.gov/ebtpages/air.html

Safer water in the dentist's office

Canadian Dental Association
http://www.cda-adc.ca/public/index.htm

The secret life of bacteria

Dr. Diane Taylor's web page
http://www.ualberta.ca/~mmi/faculty/dtaylor/dtaylor.html

AHFMR announces $40.5 million for health research

Dr. Vivian Mushahwar has come a long way from her native Jordan, gathering several degrees in the United States along the way, to live and work in Edmonton. The attraction? The excellent research group headed by Heritage Scientist Dr. Arthur Prochazka, internationally recognized for his work in nerve injury. The possibility of funding from the Alberta Heritage Foundation for Medical Research was no small part of the attraction too.

Dr. Mushahwar is a biomedical engineer who works in the area of nerve damage and repair. She uses a technique known as intraspinal microstimulation (ISMS) which involves implanting tiny, hairlike wires inside the spinal cord and passing electrical pulses through these wires to bring about leg movements. ISMS could provide a much less invasive alternative to other implantable stimulator systems currently used to help people experiencing paralysis regain limb movement and control. Dr. Prochazka was already working with the ISMS technique and Dr. Mushahwar wanted to pursue her post-doctoral fellowship under his guidance. Now, as a Heritage Scholar, she has her own lab and research team just down the hall from Dr. Prochazka.

Dr. Mushahwar is among the 53 scientists who were offered a total of $40.5 million in funding in this year's competition. Also included in this year's awards is new Heritage researcher Dr. Ken Muldrew at the University of Calgary. Dr. Muldrew studies mechanisms of freeze–thaw injury to develop techniques for cartilage and connective-tissue preservation for use in reconstructive joint surgery. At the University of Lethbridge, 2002 Heritage awardee Dr. Gerlinde Metz investigates the environmental and physiological aspects of Parkinson's disease by studying the effects of body temperature, exercise, and drug treatments on motor performance.

With the new awards, AHFMR will be funding 245 Alberta-based senior researchers in a variety of faculties at the three main provincial universities.

Applications for the senior personnel awards are peer-reviewed by scientists from all over the world, ranked by a scientific advisory committee, and finally approved by the AHFMR Board of Trustees. Researchers must meet the highest international standards of excellence in order to receive Heritage funding. It is this extremely rigorous and competitive process that has built a world-class community of health researchers in this province.

For a list of the 2002 AHFMR Senior Personnel Awards, please go to the AHFMR web site at: http://www.ahfmr.ab.ca/press/2002-03-18.shtml

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